



# Social-emotional development in very preterm infants during early infancy

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## 1. Introduction

Mental health disorders among children and adolescents are of growing importance, with an estimated prevalence of 10–20% [1]. There are now indications that these problems are major contributors to the global burden of disability [2]. In a review related to preterm infants, Johnson et al. [3] indicated that there was a 3- to 4-fold increased risk for mental health disorders in middle childhood as compared to term infants. As it has been proposed that children may benefit from early intervention [4,5], it is crucial that they be identified at an early stage. Social-emotional difficulties during infancy are considered to be a predictor of later mental health problems [6]. There has been however, relatively little investigation into the social-emotional development of very preterm infants during the first years of life. Nevertheless it has been suggested that up to a quarter of very preterm infants exhibit social-emotional delays during infancy [7–9]. Furthermore, lower social competence at two years of age has been noted for preterm infants when comparisons have been made with term born peers using the Infant Toddler Social Emotional Assessment [10] and the Brief Infant Toddler Social Emotional Assessment [11].

The Behavior Rating Scale (BRS) which is part of the Bayley Scales of Infant Development-2nd Edition (BSID-II) [12] is an observer rating scale and provides an evaluation of problems related to self-regulation and has been utilised in a number of studies of preterm infants [8,13]. It has been suggested however, that there are disadvantages with the use of the BRS as its psychometric properties are weaker than that for the BSID-II [14].

The Bayley Scales of Infant and Toddler Development, 3rd Edition (Bayley-III) [15] is the preferred tool for the cognitive assessment of preterm infants. The Bayley-III includes a social-emotional domain which is based on the Greenspan Social-Emotional Growth Chart [16]. The Bayley Social-Emotional Scale (SE) assesses functional social and emotional development and has been used in studies in which the Bayley-III was employed to assess developmental outcomes [17–19]. There is however, little information with regard to the use of the

Bayley-SE for the very preterm population [7,20,21].

The aetiology of social-emotional problems in very preterm infants is far from being completely understood [21]. There is some evidence however that these problems may be related to the influence of perinatal [22] and social risk factors [10] including maternal educational level [23]. Additionally, it has been suggested that maternal mental health problems may play a role [24,25]. Montagna [22] has also hypothesised that social-emotional problems may result from cognitive and motor impairments.

The primary aim of the present study was to compare the social-emotional development at 2-years of very preterm infants and infants born at term using the Bayley-SE Scale. The secondary aim was to determine perinatal, developmental and maternal mental health factors associated with problems in social-emotional development for the very preterm infants.

## 2. Methods

### 2.1. Participants

The mothers of the preterm (gestational age  $\leq 30$  weeks) and term control infants (gestation  $\geq 37$  weeks) in the current study had been recruited during their infants' neonatal period to participate in a parenting study as previously described [26–28]. Of the 124 preterm infants recruited in the Parenting Stress study, maternal consent for participation in the current study of social-emotional development was obtained for 96 infants (77.4%), while of the 120 term infants in the Parenting Stress study 77 (64.2%) participated in the current study. The study was approved by the Mater Health Services Human Research Ethics Committee, with all mothers giving written consent for the participation of their child in the study.

### 2.2. Procedures

Perinatal data and neonatal morbidities were obtained at hospital

*Abbreviations:* Bayley-III, Bayley Scales of Infant and Toddler Development, 3rd Edition; Bayley-SE, Bayley Social-Emotional Scale; DASS, Depression Anxiety Stress Scale; CBCL, Child Behavior Checklist

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discharge by chart review. Small for gestational age (SGA) was defined as having a birth weight for gestational age < 10th percentile [29]. Neonatal morbidities including peri-intraventricular haemorrhage (P-IVH), chronic lung disease of prematurity and retinopathy of prematurity (ROP) were coded according to the standardised criteria of the Australian and New Zealand Neonatal Network [30].

Maternal demographic Information was obtained with the mothers' overall social risk being estimated using a composite measure of five aspects of social status: family structure, maternal education, income of primary earner, language spoken at home and maternal age at child's birth. Each family was categorised as being of lower or higher social risk. The cut-off point was based on a composite social risk score as previously described [31].

### 2.3. Outcome measures

#### 2.3.1. Bayley Scales of Infant and Toddler Development – social emotional scale [15]

This is based on the Greenspan Social-Emotional Growth Chart [16]. It consists of questionnaires completed by a parent. For each item, the parent selects one of six ratings from: 0 (can't tell) to 5 (all of the time). A Scaled Score is then obtained dependent on the child's age from which a Composite Score is produced (mean 100; standard deviation [SD] 15). The Bayley-SE assesses the acquisition of social and emotional milestones. It includes items that assess the child's mastery of functional emotional skills such as self-regulation, communication abilities including the use emotional signals or gestures, the child's ability to engage with others and to use emotions in an interactive and purposeful manner. Internal reliability as assessed by Chronbach's  $\alpha$  for the age group of the infants enrolled in the present study is indicated in the Bayley-III manual as 0.92–0.94 [15]. A separate study has reported Chronbach's  $\alpha$  to be 0.95 [32]. While statistical validity has not been performed, analyses have indicated that the items in the questionnaire are age-appropriate [16].

#### 2.3.2. Depression Anxiety Stress Scales (DASS) [33]

The DASS is a 42 item self-report questionnaire designed to measure the states of depression, anxiety and stress and was completed by the mothers. Z-scores were determined for each of the three scales and then averaged producing a composite DASS result. Those with a Z-score > 1 were considered to have moderate expression for the DASS.

#### 2.3.3. Child Behavior Checklist (CBCL) 1.5–5 [34]

A 99-item parent report that measures emotional and problem behaviors of children. A T-score is produced and both internalizing and externalising behavior subscales can be derived.

Neurosensory Impairment assessment was conducted at 2-years (corrected for prematurity for the preterm cohort) by a neurodevelopmental team blinded to the child's history and included a neurological examination assessment for cerebral palsy [35]. A Bayley-III assessment for cognitive, language and motor abilities was administered by trained examiners. Information on hearing impairments requiring aids and bilateral blindness was obtained from the parents.

### 2.4. Statistical analyses

Descriptive maternal and infant characteristics are presented for the preterm and term groups. Univariate analyses comparing mothers of infants from each group were performed using *t*-tests or  $\chi^2$  tests as appropriate. Infant characteristics and outcomes were analysed by the use of generalized estimating equations (GEE) regression as this takes into account the correlated nature of data from infants of multiple births. The Bayley-SE scores for the preterm infants were compared to the term infants with the scores for the preterm infants also being adjusted based on the mean score of the term control group as previously reported for the Bayley-III scales [36,37]. The combined independent

**Table 1**

Maternal sociodemographic and infant characteristics for the preterm and term groups.

	Preterm	Term	p Value
Maternal characteristics	n = 79	n = 64	
Maternal age - mean (SD)	30.24 (5.33)	31.67 (4.72)	0.09
Multiple pregnancy, n (%)	17 (21)	13 (20)	0.86
Caesarean section, n (%)	49 (62)	31 (48)	0.10
Parity, 1st baby, n (%)	60 (59)	52 (53)	0.37
Married/defacto relationship, n (%)	75 (95)	61 (95)	0.93
Ethnicity, White/Caucasian n (%)	70 (89)	62 (97)	0.065
Public insurance status, n (%)	42 (54)	27 (42)	0.19
Educational level			
Schooling complete, n (%)	59 (74)	59 (92)	0.006
Smoking during pregnancy, n (%)	15 (19)	5 (8)	0.052
High social risk, n (%)	23 (30)	5 (8)	0.001
Infant characteristics	n = 96	n = 77	
Male infant, n (%)	51 (53)	42 (55)	0.82
Birth weight (g) – mean (SD)	1074 (327)	3315 (583)	
Weight < 1000 g, n (%)	43 (45)		
Gestation (weeks) – mean (SD)	27.6 (2.0)	38.6 (1.4)	
Born < 28 weeks, n (%)	42 (43)		
Small for gestational age, n (%)	16 (13)	15 (12)	0.93
Peri-intraventricular haemorrhage, n (%)	9 (9)		
Chronic lung disease, n (%)	16 (17)		
Retinopathy of prematurity, n (%)	50 (52)		

SD, standard deviation.

effects of factors associated with the Bayley-SE were analysed using multivariate GEE. Statistical analyses were deemed significant at the 0.05 level. All analyses were performed in Stata version 13.1 (Statacorp Ltd., College Station, Texas).

### 3. Results

The questionnaires were completed by the mothers at a mean age [Standard Deviation (SD)] 25.1 [2.3] months for the preterm group of infants (corrected for degree of prematurity) and 24.7 [2.4] months for the term group. The preterm group consisted of 96 babies of whom 34 were twins, while the term group consisted of 77 babies of whom 26 were twins. The maternal and infant characteristics of the preterm and term cohorts are presented in Table 1.

The baseline characteristics of those assessed and those not studied were comparable with the exception of birth weight (consented infants - mean 1249 g [SD 366] v non-consented - mean 1074 g [SD 327];  $p = 0.017$ ) in the preterm group and mean gestational age (consented - (39.3 [SD 1.3] v non-consented 38.6 [1.4] weeks;  $p = 0.006$ ) in the term group.

The results of assessment at 2-years of age are displayed in Table 2. The Bayley-III was performed for 89 preterm infants and 65 term infants. For the 19 infants for whom the Bayley-III could not be performed, this was due to distance from the assessment centre, behavioral difficulties during testing, or failure to attend for appointments. On analysis of the DASS the preterm mothers had significantly greater levels of mental health problems. On the CBCL, significantly higher scores for both internalizing and externalising behaviors were found in the preterm infants.

The mean composite score on the Bayley-SE was lower for preterm infants (103.18, SD 16.22) than for term infants (109.61, SD 14.86). This difference was significant when adjusted for multiple birth; 7.47 (95% Confidence Interval 2.44–12.51;  $p = 0.004$ ). Seven (7.3%) preterm infants had a Bayley-SE score < 85, i.e. > 1 SD below the standardised mean for the assessment with 25% of preterm infants having a score > 1 SD below the mean of the term cohort in this study. No term infant had a Bayley-SE score < 85.

The relationship between the Bayley-SE score and maternal

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